

(21) Application No 9920075.0

(22) Date of Filing 24.08.1999

(71) Applicant(s)  
**Telelogic Doors UK Limited**  
(Incorporated in the United Kingdom)  
Northbrook House, Oxford Science Park, OXFORD,  
OX4 4GA, United Kingdom

(72) Inventor(s)  
**Richard Stevens**

(74) Agent and/or Address for Service  
**Beresford & Co**  
2-5 Warwick Court, High Holborn, LONDON,  
WC1R 5DJ, United Kingdom

(51) INT CL<sup>7</sup>  
**G06F 17/30**

(52) UK CL (Edition S )  
**G4A AUB AUB**

(56) Documents Cited  
**EP 0883068 A2 EP 0589070 A1 WO 98/36343 A2**  
**WO 95/26532 A1 US 5933831 A US 5019961 A**  
**Procs. 21st Annl. Hawaii Intl. Conf. System Sciences,**  
**1988 Vol II, pp.694-704, Graphical Entity Relat**

(58) Field of Search  
UK CL (Edition R ) **G4A AUB AUB**  
INT CL<sup>7</sup> **G06F 17/30**

(54) Abstract Title  
**Information processor stores information objects and associated attributes**

(57) There is described an information processing apparatus in which information is stored as a plurality of information objects in a first memory region, each information object having associated attributes for storing data indicating characteristic details of the information stored in that information object. Selection means are provided for selecting one of a plurality of presentation layers stored in a second memory region, the stored presentation layers including presentation layers operable to display information in a format selected from the group of formats comprising a data flow diagram, a state transition diagram and an entity relationship diagram (as shown).

Each information object has an attribute indicating whether that object is relevant to a predetermined one of the presentation layers, and information objects may be selected for display on the basis of the attribute.

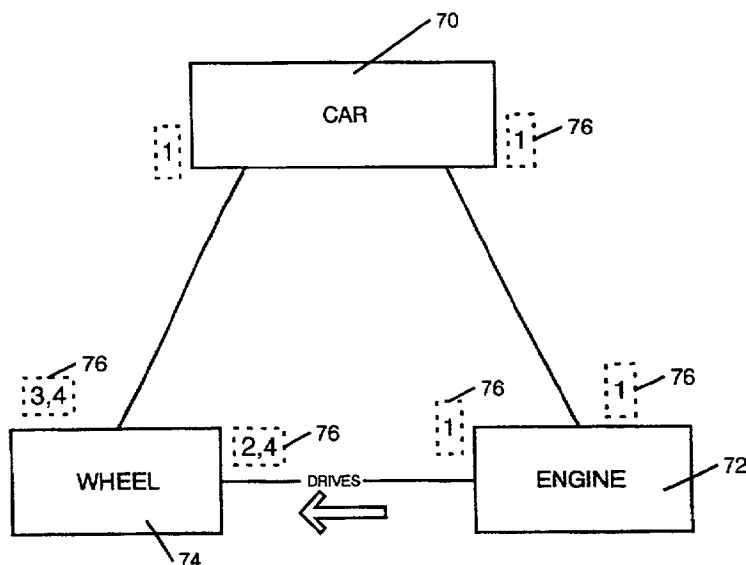
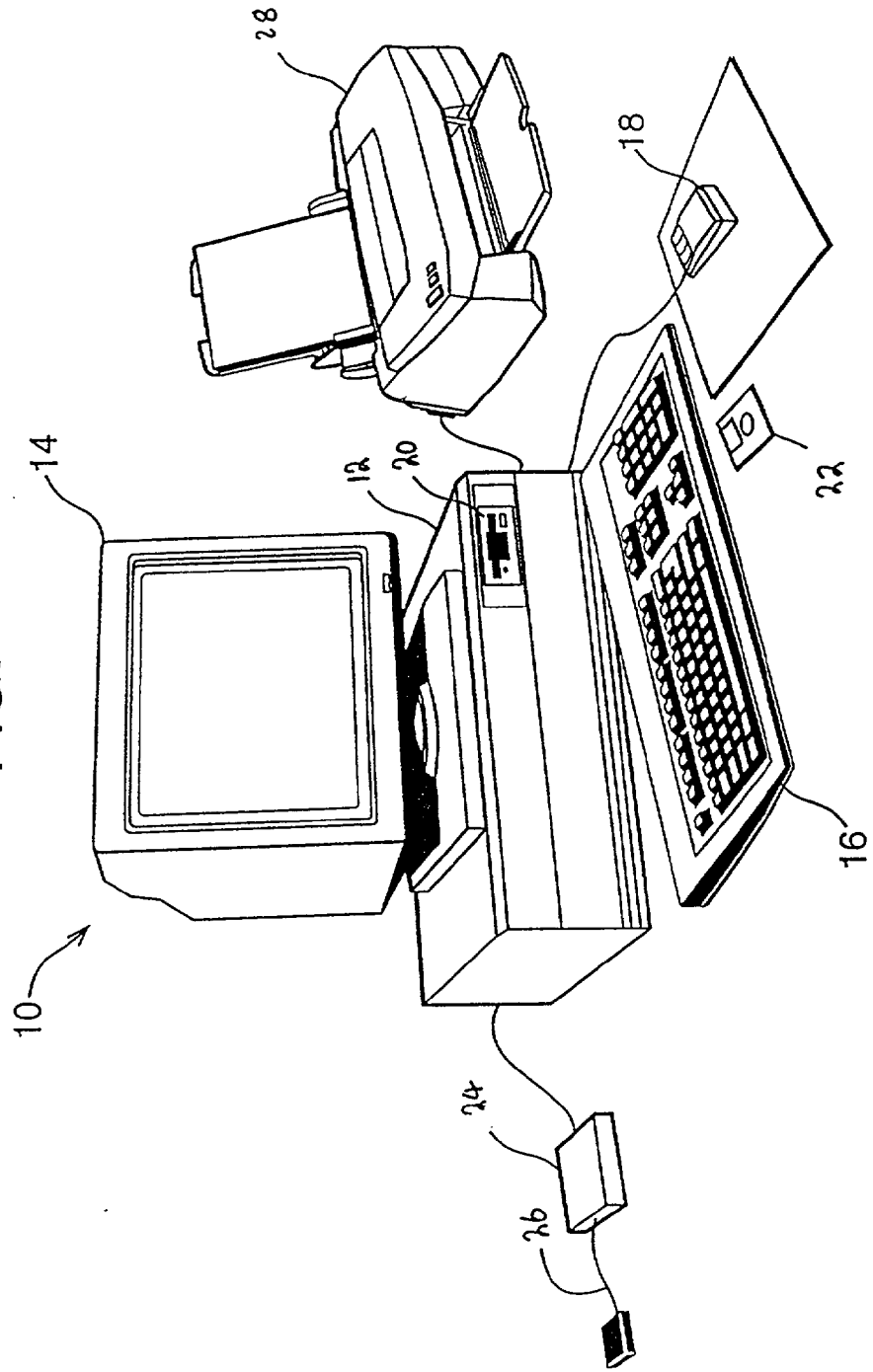


FIG. 5

FIG. 1



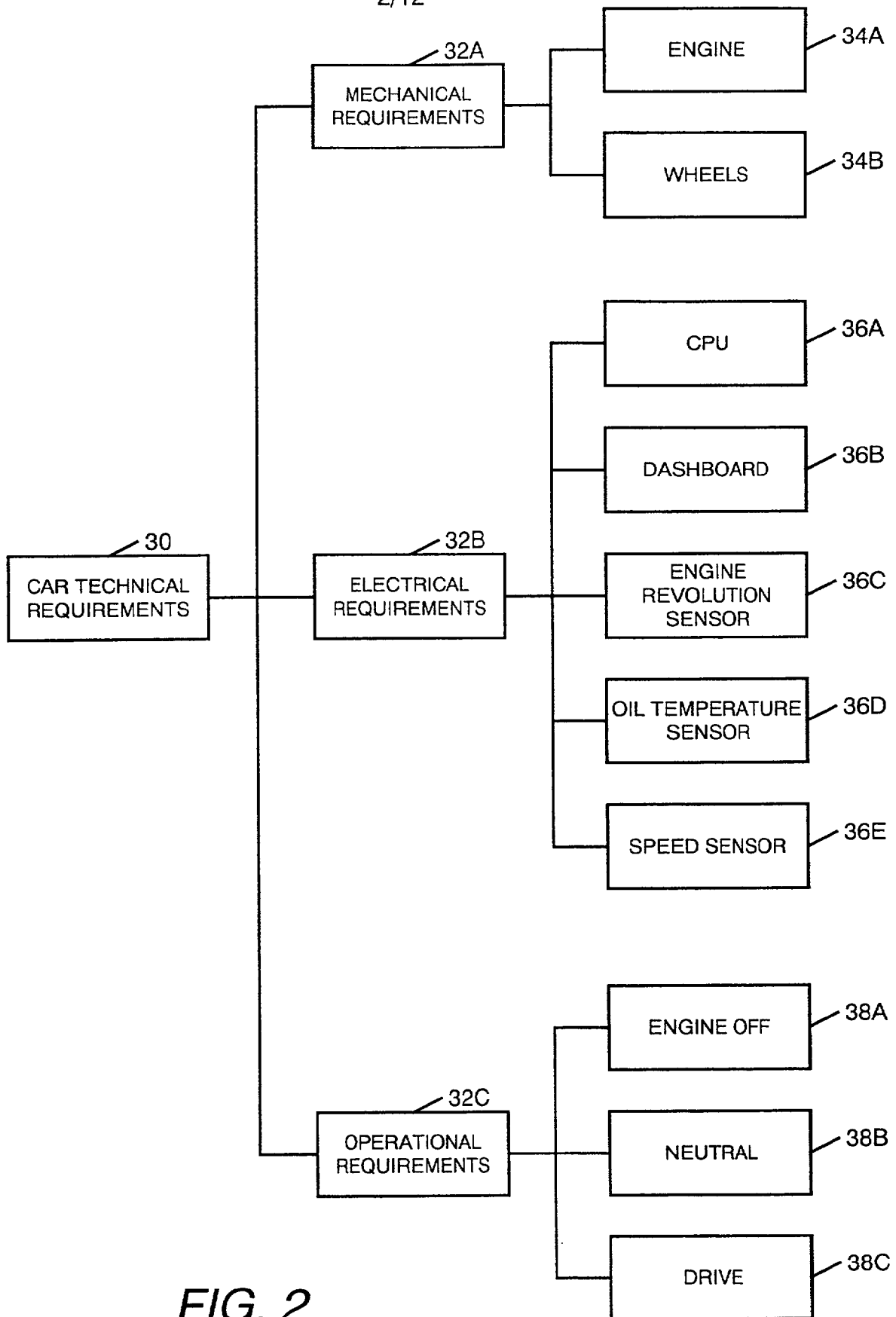
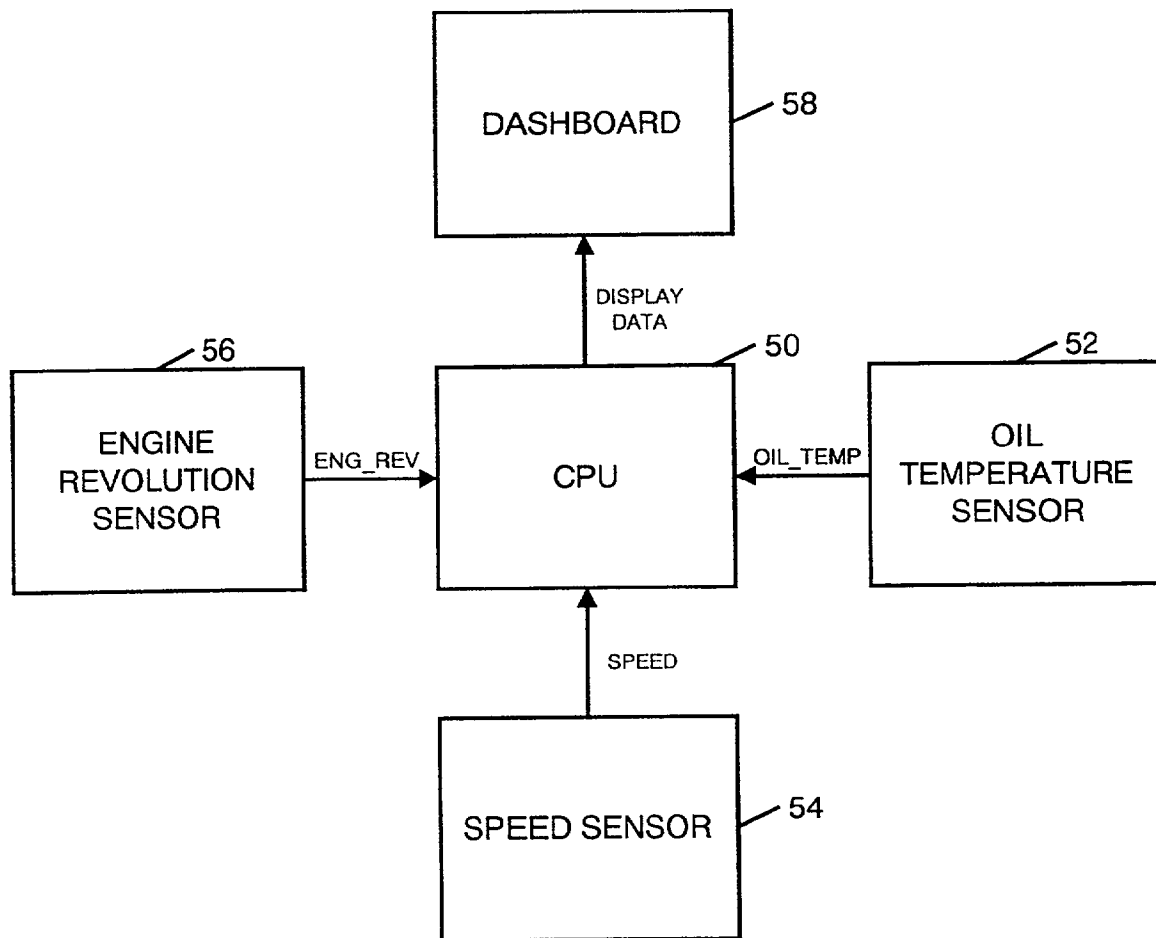
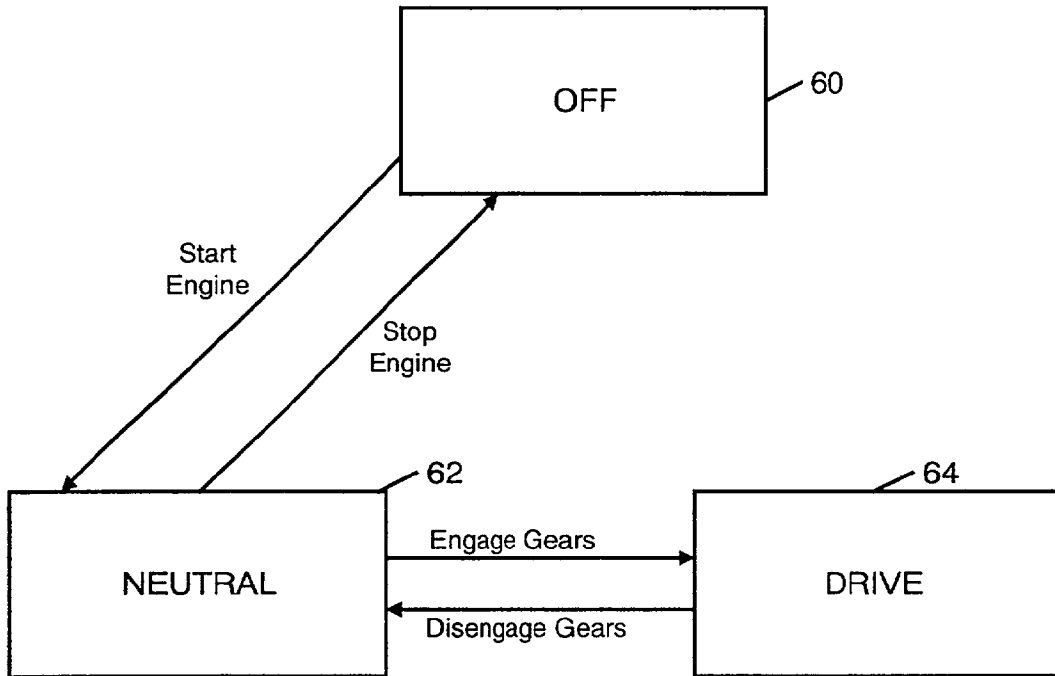
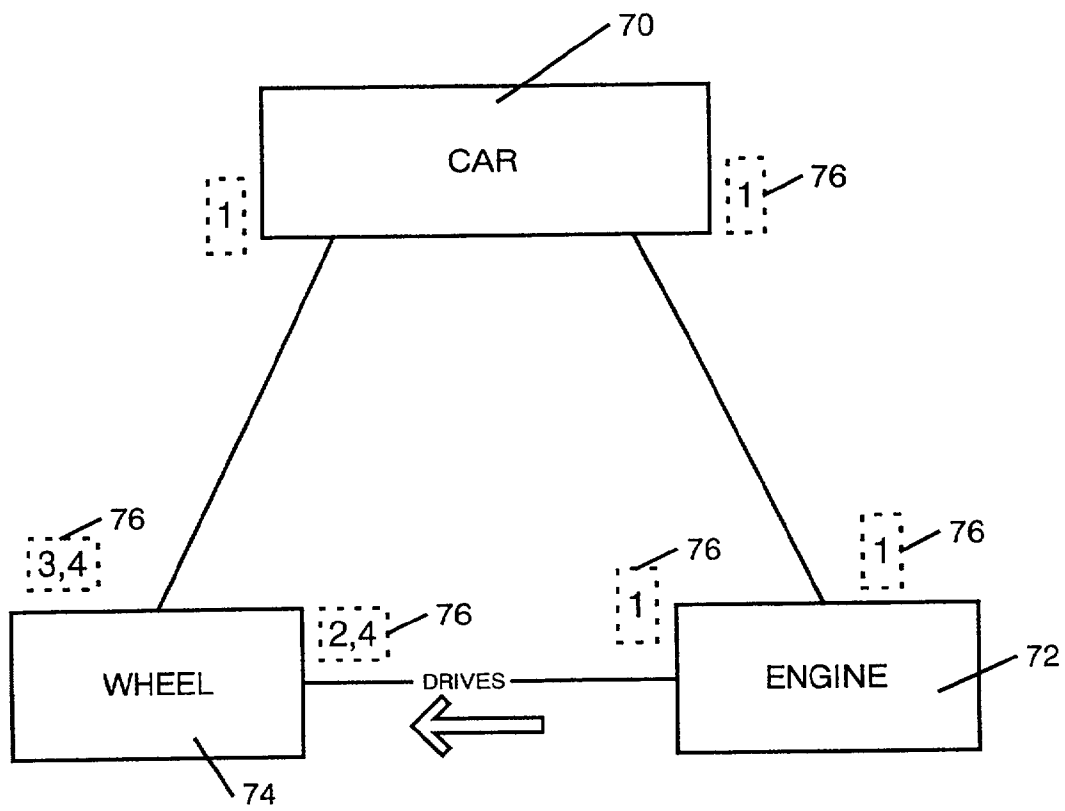


FIG. 2

**FIG. 3**



*FIG. 4*



**FIG. 5**

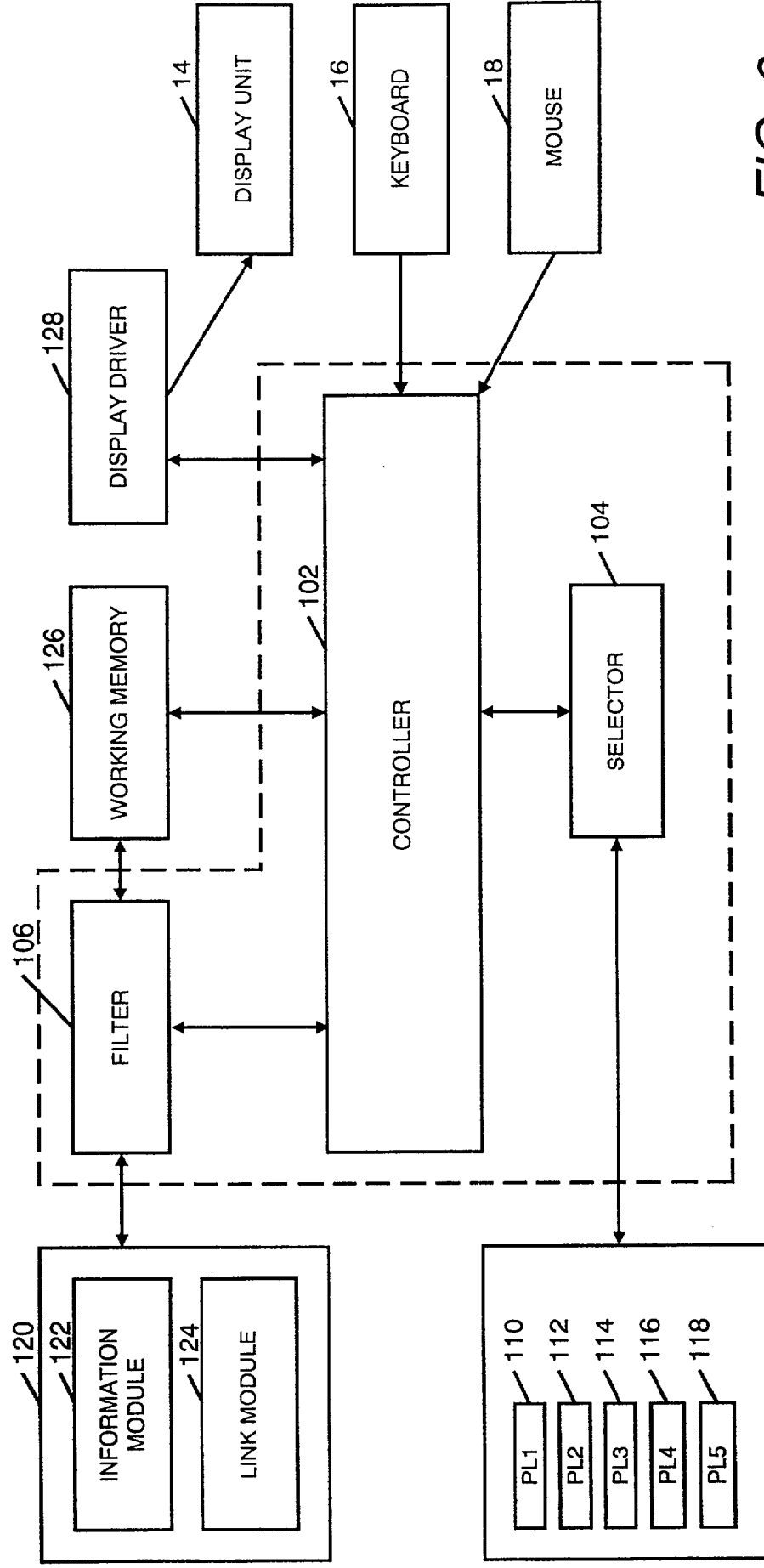
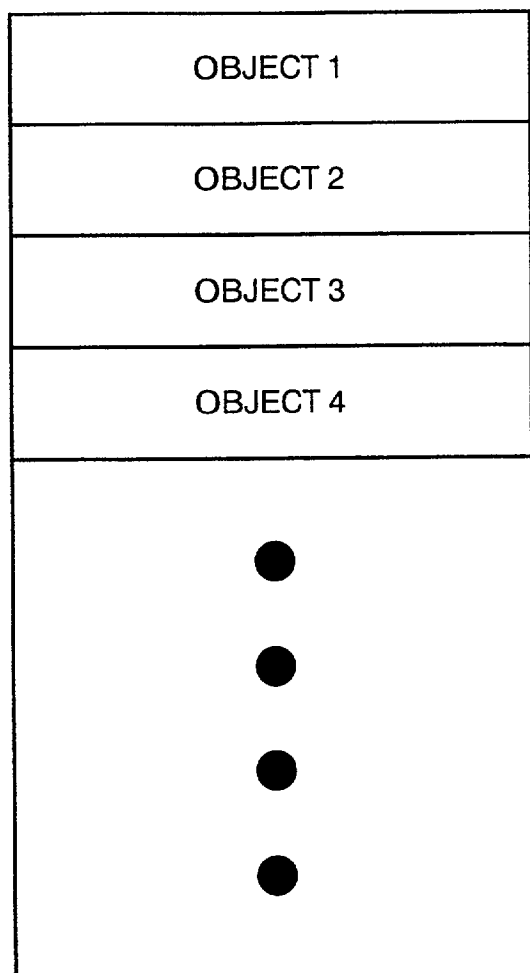


FIG. 6



*FIG. 7*



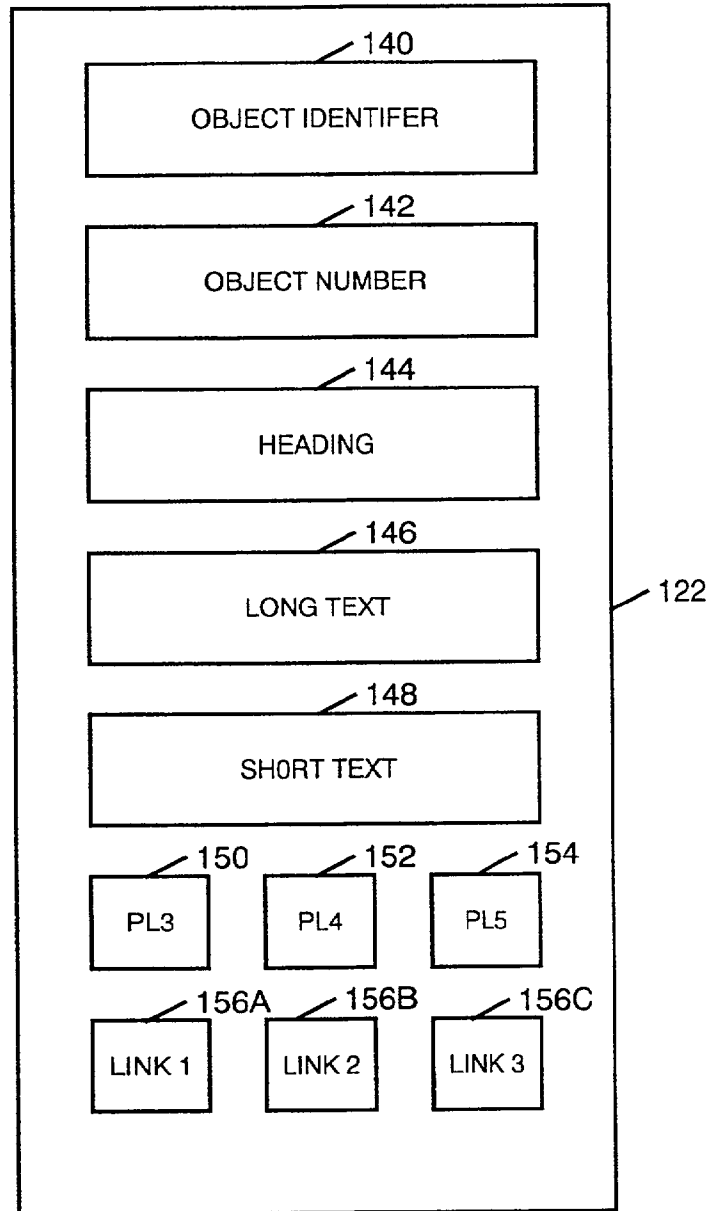
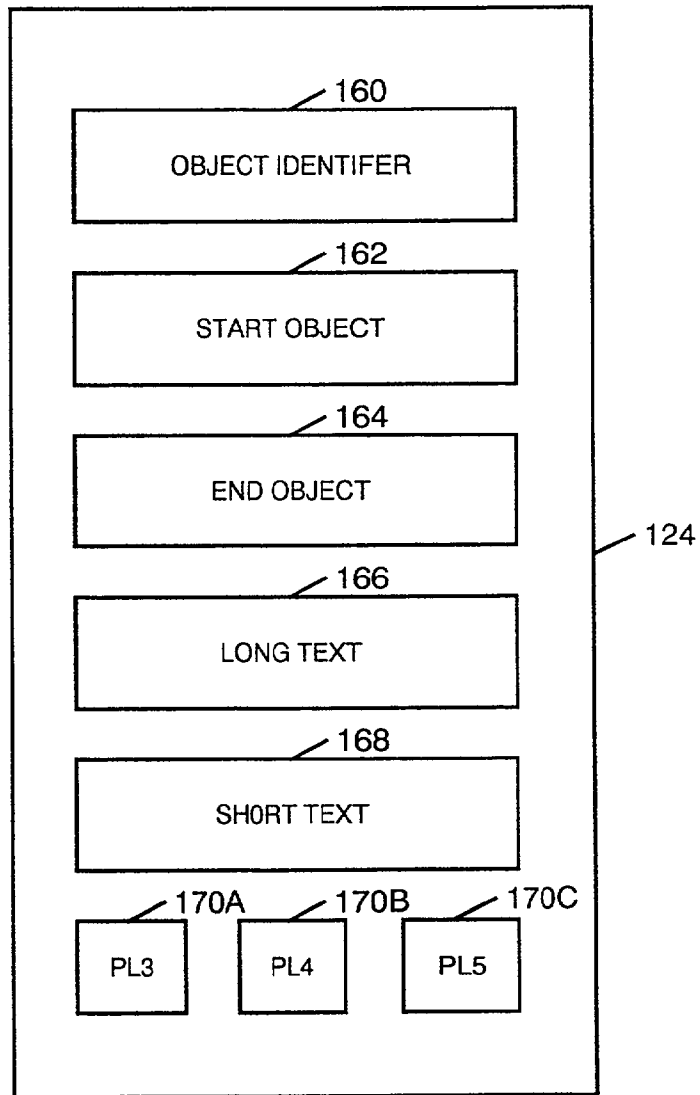
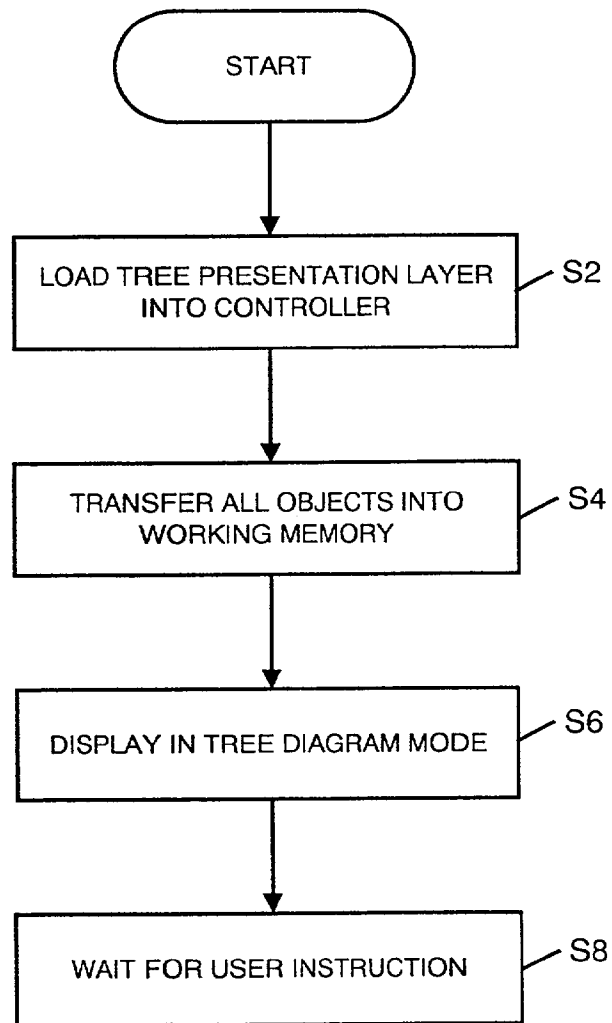


FIG. 8



**FIG. 9**

*FIG. 10*

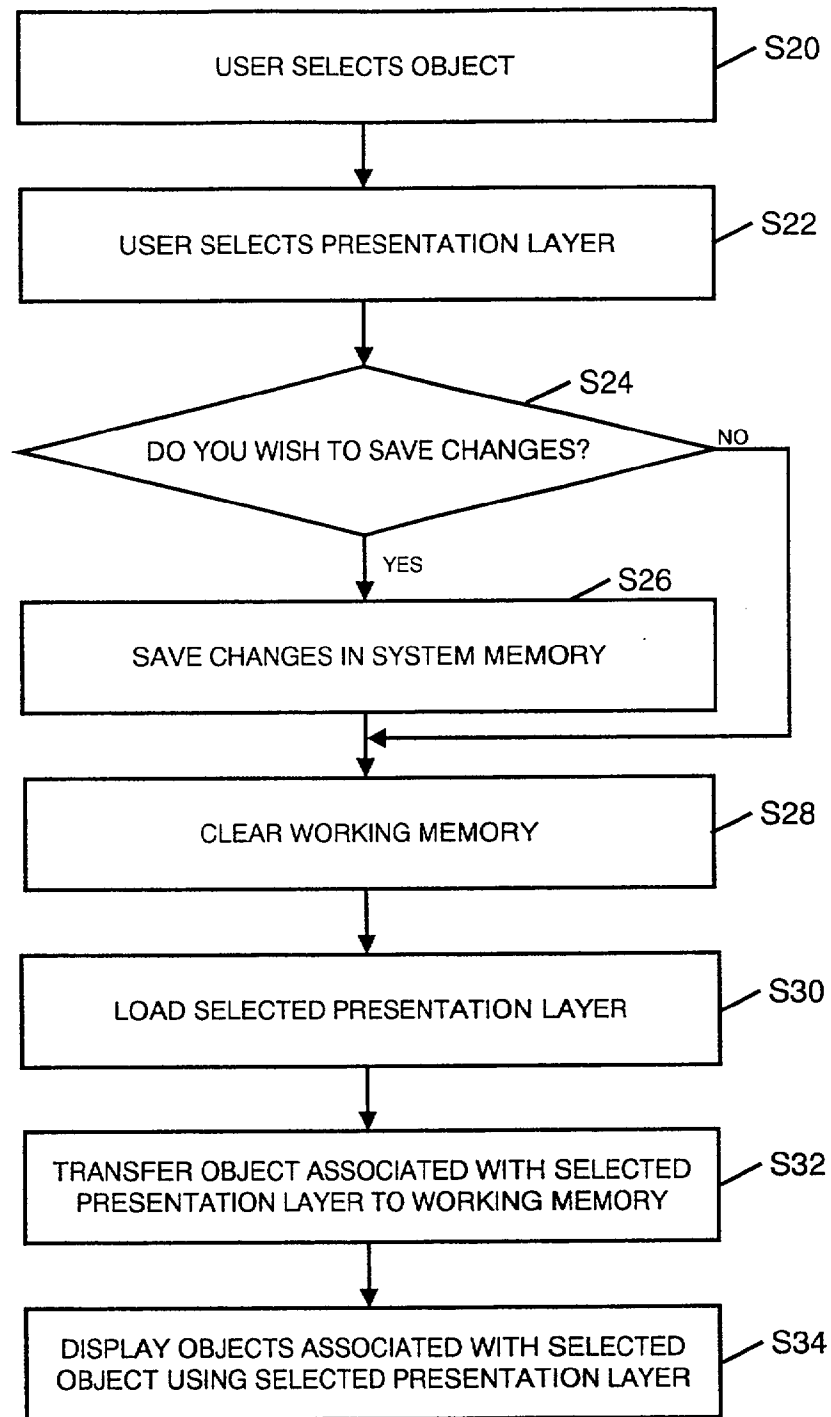
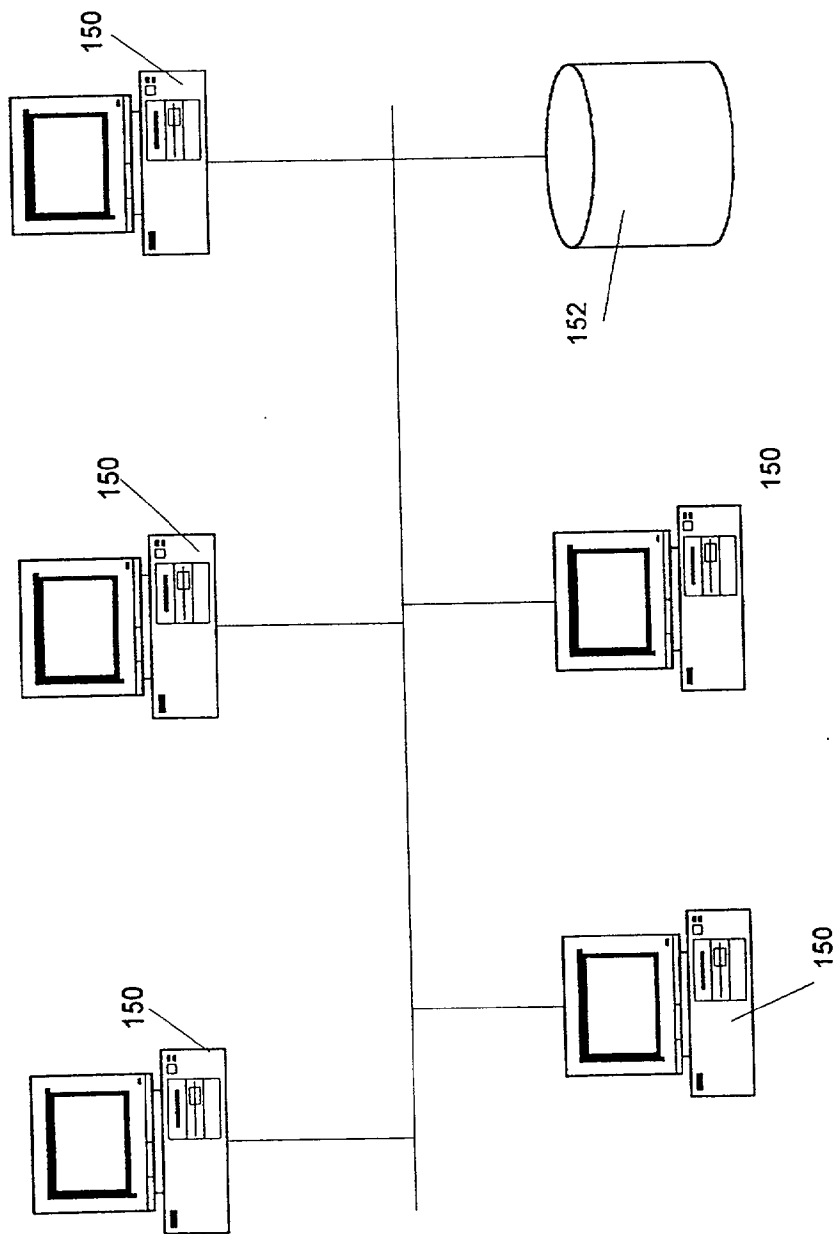


FIG. 11

Fig 12

12/12



INFORMATION PROCESSING APPARATUS AND METHOD

This invention relates to a method of processing and  
5 displaying information and an apparatus therefor. The  
invention has particular, but not exclusive, relevance to  
a software package run on a conventional computer for  
organising the initial planning stage of a project to  
develop a new technical system.

10

When planning the development of a new system one of the  
first tasks faced is to identify what the system must be  
able to do, in other words the requirements which the  
system needs to satisfy. These requirements can arise in  
15 a number of ways, for example there may be legal  
requirements such as safety requirements, technical  
requirements and user requirements. It is important that  
in the initial planning stage of a system design project  
all the requirements of the end system are fully  
20 evaluated and that any conflicts, for example between  
user requirements and legal requirements, are resolved  
because once the technical development has started any  
changes to the system specification can prove costly in  
both time and money.

25

DOORS (Registered Trade Mark) is a computer software  
package available from Quality Systems & Software

Limited, Magdalen Centre, Oxford Science Park, Oxford OX4  
4GA, United Kingdom which is designed to help engineers  
in the planning stage of system development. The DOORS  
software package separates information relating to a  
5 project into components and stores each component of  
information in a database in what is commonly termed an  
object.

An object is a file structure which has a plurality of  
10 data storage areas in which information can be stored,  
and a register giving details of the location of each of  
the data storage areas in a memory and the type of  
information stored in each of the data storage areas.  
The type of information stored in a data storage area of  
15 an object is referred to as an attribute of that object,  
the attribute being able to have a number of values. For  
example, one attribute of an object may specify the date  
on which the object was last amended, with that date  
being stored as the value of the attribute.

20

In the DOORS software package, each component of  
information is stored as the value of an attribute of a  
respective object. An advantage of assigning one  
attribute of an object to store a component of  
25 information is that further data related to that  
component of information can be stored as values of other  
attributes of the same object. These values can be

either automatically generated, for example the value of an attribute specifying the date on which the object was last modified, or user-generated, for example the value of an attribute specifying the level of priority attached  
5 to the component of information stored in the object.

In the DOORS software package, sets of objects which are related and have identical attributes, although the attributes will generally have different values, are  
10 grouped together in modules. Each of these modules is arranged in a hierarchical arrangement with one of the attributes of each object in a module storing a value specifying the position of that object in the hierarchical arrangement. Information stored in the  
15 objects of a module can be viewed either in a tree diagram mode, in which the hierarchical arrangement can be seen but it is not normally possible to view full details of all of the information components, or in a text mode, in which an individual information component  
20 stored in an object can be viewed in detail but it is not normally possible to see how that component of information is related to other components of information.

25 The DOORS software package also enables links to be established between objects in different modules. These links are useful in identifying potential conflicts,



particularly where one module stores one set of requirements and another module stores a separate set of requirements.

5 An advantageous aspect of the DOORS software package is that if a change is made to the document while in one of the display modes, the change is also automatically made in the other display mode, thereby reducing the amount of work needed to be done by the user. The possibility of  
10 introducing incorrect data is also reduced, lessening the risk that the information displayed in the two presentation modes is not consistent.

While the DOORS software package is a valuable tool for  
15 aiding the development of a new system, a problem which can be encountered is that the amount of information which needs to be processed makes it hard to identify which components of information are related to each other. This invention has been made bearing this problem  
20 in mind.

The invention provides an information processing apparatus for processing information stored as a plurality of information objects, each information object  
25 having associated therewith a plurality of attributes for storing data indicating predefined characteristic details of the information stored in that information object,

said information processing apparatus comprising: a first memory for storing the plurality of information objects; a second memory for storing a plurality of presentation layers, each of the presentation layers corresponding to a respective different format for displaying at least part of the information stored in the information objects on a display; means for selecting one of the presentation layers stored in the second memory; and means for displaying at least part of the information in accordance with the selected presentation layer, wherein said selection means is operable to select presentation layers from the second memory for displaying information in a format selected from the group of formats comprising a data flow diagram, a state transition diagram and an entity relationship diagram. Data flow diagrams, state transition diagrams and entity relationship diagrams each display only certain types of information component and links between those information components and therefore have the advantage that as only data relevant to the diagram is displayed it is easier to recognise how components of information are related to each other. Such diagrams are particularly useful in the early stages of systems design to create a skeleton about which the full system specification can be built.

25

The invention further provides an information processing apparatus for processing information stored as a

plurality of information objects, each information object having associated therewith a plurality of attributes for storing data indicating predefined characteristics of the information stored in the information object, said  
5 information processing apparatus comprising: a first memory for storing the plurality of information objects; a second memory for storing a plurality of presentation layers, each of the presentation layers corresponding to a respective different format for displaying at least  
10 part of the information stored in the information objects on a display; means for selecting one of the presentation layers stored in the second memory; and means for displaying at least part of the information in accordance with the selected presentation layer; wherein an  
15 attribute is assigned to each information object for each presentation layer indicating whether or not that information object is relevant to that presentation layer.

20 Having an attribute assigned to each information object for each presentation layer indicating whether or not that information object is relevant to the presentation layer enables the display means quickly to identify the information which is relevant to a selected presentation  
25 layer.

Preferably, the information processing apparatus further

comprises means for filtering all the information objects relevant to a selected presentation layer from the first memory to a third memory in accordance with the attribute associated with the selected presentation layer. Thus, 5 the third memory can act as a working memory and access times to data in the working memory can be reduced as the amount of data in the working memory is reduced.

Exemplary embodiments of the invention will now be 10 described with reference to the attached figures in which:

Figure 1 shows a computer apparatus;

Figure 2 shows an exemplary display in a tree diagram presentation mode;

15 Figure 3 shows an exemplary display in a data flow diagram presentation mode;

Figure 4 shows an exemplary display in a state transition diagram presentation mode;

20 Figure 5 shows an exemplary display in a entity relationship diagram presentation mode;

Figure 6 shows a schematic diagram illustrating the main functional components of the information processing apparatus of the first embodiment;

25 Figure 7 is a schematic diagram illustrating the contents of a module of the first embodiment;

Figure 8 is a schematic diagram illustrating the contents of an information object in the module of the

first embodiment;

Figure 9 is a schematic diagram illustrating the layout of a link object of the first embodiment;

Figure 10 shows the processing steps carried out  
5 when the information processing software is run in the first embodiment;

Figure 11 shows the processing steps carried out when a user changes the presentation mode in which a selected object is viewed; and

10 Figure 12 shows a schematic block diagram of a computer network of the second embodiment.

A first embodiment of the invention will now be described in which a software package according to the invention is  
15 run on a conventional computer. Figure 1 shows such a conventional computer 10 having a processing unit 12 with a display unit 14, keyboard 16 and mouse 18 each connected thereto. The processing unit 12 has a disk drive 20 into which a disk 22 can be inserted. The disk  
20 22 can be used to store the software package according to the invention and/or data for subsequent transfer to the processing unit 12 via the disk drive 20. The processor unit 12 is also connected to a modem 24 which is in turn connected to a plug 26 which can be inserted into a  
25 telephone socket (not shown) so that the software package and/or data can alternatively be downloaded in the form of signals transmitted over the internet. The processing

unit 12 is also connected to a printer 28.

When the computer 10 runs the software package according to the invention, information concerning the planning of a project can be presented to a user via the display 14 using one of five display modes, and amended by the user via the keyboard 16 and the mouse 18. For exemplary purposes, the display modes will now be described, with reference to Figures 2 to 5, for a document detailing the technical requirements of a new car.

#### Text mode

The text mode facilitates viewing in detail parts of a document. The document is split into sections numbered using the legal numbering system. That is the document is split into main sections numbered 1, 2, 3,...; each of the main sections is split into primary sub-sections which are numbered by first indicating the number of the associated main section followed by a dot and then the number of the primary sub-section, for example section 2 is split into primary sub-sections numbered 2.1, 2.2, 2.3,...; the primary sub-sections are in turn split into secondary sub-sections, for example the primary sub-section 2.2 is split into secondary sub-sections numbered 2.2.1, 2.2.2, 2.2.3,... and so on. In this way a hierarchical arrangement is formed.

Each section and sub-section has information associated with it. This information could be, for example, a block of text, a graph or a table. This information will henceforth be referred to as the long text regardless of  
5 the actual format. Each section and sub-section also has a title, and a summary of the long text which will henceforth be referred to as the short text.

For the car technical requirements example, the document  
10 is split into three sections numbered 1, 2 and 3 describing the mechanical requirements, the electrical requirements and the operational requirements respectively. The mechanical requirements section is split into two sub-sections, numbered 1.1 and 1.2,  
15 describing the engine and the wheels respectively; the electrical requirements section is split into five sub-sections, numbered 2.1, 2.2, 2.3, 2.4 and 2.5, describing the central processing unit, the dashboard, an engine revolution sensor, an oil temperature sensor and a speed  
20 sensor respectively, and the operational requirements section is split into three sub-sections, numbered 3.1, 3.2 and 3.3, describing the operational requirements when the engine is off, when the engine is in neutral, and when the engine is driving the wheels, respectively.

### Tree diagram mode

The tree diagram mode facilitates viewing of the hierarchical structure of the document. As can be seen  
5 in Figure 2, the document describing the car technical requirements, which is represented by the block 30, is split into three sections. The first section describing the mechanical requirements is represented by the block 32A, the second section describing the electrical  
10 requirements is represented by the block 32B, and the third section describing the operational requirements is represented by the block 32C. The blocks 34A and 34B represent the two sub-sections of the mechanical requirements section described above. The blocks 36A,  
15 36B, 36C, 36D and 36E represent the five sub-sections of the electrical requirements described above. The blocks 38A, 38B and 38C represent the three sub-sections of the operational requirements described above.

### 20 Data flow diagram mode

A data flow diagram facilitates the viewing of how data is transferred between functional areas of a system. In the data flow diagram mode blocks are displayed which  
25 represent respective different functional areas of a system and links are shown between the blocks which correspond to flows of information between the functional



areas of the system. In this embodiment, all of the blocks originate from the same level of the hierarchical arrangement of the document.

- 5 Figure 3 is a data flow diagram showing how data flows between the functional areas forming the electrical system of the car. Thus, a processor 50 receives a signal "OIL\_TEMP" from an oil temperature sensor 52, a signal "SPEED" from a speed sensor 54, and a signal  
10 "ENG\_REV" from an engine revolution sensor 56. The processor 50 analyses this data and sends a signal "DISPLAY\_DATA" to a dashboard 58 which presents information to the driver of the car.
- 15 Data flow diagrams are also known as functional block diagrams or collaboration diagrams.

#### State transition diagram mode

- 20 A state transition diagram is used to represent the dynamic behaviour of a system. The state transition diagram illustrates each state that a system can be in as a block and links are shown between the blocks indicating the events which cause the system to move between the  
25 states corresponding to the linked blocks.

Figure 4 shows a state transition diagram for the

operational requirements of the car. The three possible states are represented by the block OFF 60, in which state the engine is turned off, the block NEUTRAL 62, in which state the engine is turned on but the gears are not engaged, and the block DRIVE 64, in which state the engine is turned on and the gears are engaged. As can be seen in Figure 4, a link going from the OFF state 60 to the NEUTRAL state 62 has associated information concerning the event which takes place to move the system from the OFF state to the NEUTRAL state, that is "START ENGINE". Similarly, Figure 4 shows that when the car is in the NEUTRAL state 62 and the gears are engaged the car moves to the DRIVE state 64, when the car is in the DRIVE state 64 and the gears are disengaged, the car moves to the NEUTRAL state 62 and when the car is in the NEUTRAL state 62 and the engine is stopped, the car is moved to the OFF state 60.

Figure 4 illustrates a valuable property of state transition diagrams, that is that the system should be designed so that transitions between certain states are not allowed. Thus, when the car is in the DRIVE state 64 it should not be possible to turn the engine off.

State transition diagrams are also referred to as work flow diagrams.

Entity relationship diagram mode

An entity relationship diagram illustrates the key elements of a system and how these elements are related to each other.

As shown in Figure 5, the key elements are represented by the block 70 marked car, the block 72 marked engine and the block 74 marked wheel the link between the car block 70 and the engine block 72 has associated information which indicates that the relationship is that the car has an engine. The link between the car block 70 and the wheel block 74 indicates that the car has wheels and the link between the engine block 72 and the wheel block 74 indicates that the engine drives the wheels. The directionality associated with the link between the engine block and the wheel block indicates that the engine drives the wheels, and not vice versa.

At each end of each link there is shown data associated with that end of the link, indicating the number of entities which are associated with that link. In the example shown, the information "3, 4" at the lower end of the link between the 'Car' entity and the 'Wheel' entity indicates that each car is associated with 3 or 4 wheels, while the number 1 at the upper end of the link signifies that each wheel is associated with only one

car. The number of entities associated with the end of a link in an entity relationship diagram is referred to as the cardinality.

- 5 Entity relationship diagrams are sometimes referred to as information models.

As described above, data flow diagrams, state transition diagrams and entity relationship diagrams illustrate  
10 different ways of identifying relationships between elements of a system and have the common property that when one of these modes is selected only information that is relevant to the selected mode is displayed, the remaining information being ignored. This is  
15 particularly advantageous when analysing complicated systems for which there is a large amount of information because not all of the information need be viewed at any one time.

- 20 On running the software package according to the invention, the conventional computer 10 is formatted as shown in Figure 6 in which a processor 100, indicated by broken lines, located in the processing unit 12 is schematically separated into three components, a  
25 controller 102, a selector 104 and a filter 106.

A first memory 108 stores five presentation layers with

each presentation layer containing instructions as to how to display information using a respective one of the above-described five presentation modes. Thus the block 110 marked "PL1" represents a presentation layer specifying how to present information in a text mode, the block 112 marked "PL2" represents a presentation layer specifying how to present information in a tree diagram mode, the block 114 marked "PL3" represents a presentation layer specifying how to present information in a data flow diagram mode, the block 116 marked "PL4" represents a presentation layer specifying how to present information in a state transition diagram mode and the block 118 marked "PL5" represents a presentation layer specifying how to present information in an entity relationship diagram mode.

The keyboard 16 and the mouse 18 are connected to the controller 102 and enable a user to input instructions. The controller 102 is also connected to the selector 104 which, in response to an instruction from a user selecting one of the presentation modes, transfers the presentation layer for the selected presentation mode from the first memory 108 to a controller 102.

A second memory 120 stores the data making up the document which will be processed and displayed. In this exemplary embodiment, the data stored in the second

memory 120 consists of an information module 122 and a link module 124. The information module 122 and link module 124 each consists of a plurality of objects, as shown schematically in Figure 7. The objects stored in the information module 122 will hereinafter be referred to as information objects and the objects stored in the link module 124 will hereinafter be referred to as link objects.

As shown in Figure 8, each of the information objects has an object identifier attribute, represented by the block numbered 140, which stores a unique identifier by which that information object can be identified. Each information object also has attributes for storing the object number (represented by the block 142), the heading (represented by the block 144), the long text (represented by the block 146) and the short text (represented by the block 148).

Each information object also has an attribute, represented by the block numbered 150, which can have one of two values, one of the two values indicating that the information stored in that object is relevant to a data flow diagram and the other of the two values indicating that the information stored in that object is not relevant to a data flow diagram. Similarly each information object has attributes represented by the

blocks numbered 152 and 154 indicating whether or not the information stored in the information object is relevant to a state transition diagram or an entity relationship diagram respectively.

5

Each information object further has a number of link attributes, represented in Figure 8 by the blocks numbered 156A, 156B and 156C. Although only three link attributes are illustrated, it will be appreciated that  
10 more or less could actually be associated with each object. Each of the link attributes 156A, 156B and 156C stores an object identifier of one of the link objects stored in the link module 124.

15 Each of the link objects stored in the link module 124 stores details of the relationship between the information stored in two different information objects. As shown in Figure 9, each link object has an attribute for storing a unique object identifier, represented by  
20 the block numbered 160. Each link object further has attributes for storing the object identifier of an information object which forms the start of a link (represented by the block numbered 162), the object identifier of an information object which forms the end  
25 of a link (represented by the block numbered 164), a long text providing details of the link (represented by the block numbered 166) and a short text giving a summary of

the long text (represented by the block numbered 168).

As with the information objects, each link object also has attributes, represented by the blocks numbered 170A, 170B and 170C, for storing information indicating whether or not the information stored in that link object is relevant to a data flow diagram, state transition diagram and an entity relationship diagram respectively.

Returning to Figure 6, the controller 102 is connected to the filter 106 and a working memory 126. The filter 106, under the control of the controller 102, transfers the information objects and link objects that are relevant to a selected presentation mode to the working memory 126. The controller 102 is also connected to a display driver 128 which is in turn connected to the display unit 14.

The operation of the conventional computer programmed with the software package according to the present invention will now be described with reference to Figures 10 and 11.

As shown in Figure 10, when the software package according to the present invention is first run, the controller 102, in step S2, automatically instructs the selector 104 to transfer the presentation layer PL2 to the controller 102. Thus, the tree diagram mode is



programmed to be the default presentation mode.

The controller 102 subsequently, in step S4, instructs the filter 106 to transfer all the information objects  
5 and the link objects stored in the second memory 120 to the working memory 126. The controller 102 then sends signals to the display driver 128 in step S6 to display the complete tree diagram with the headings of each information object displayed. The controller then waits  
10 for a user instruction in step S8.

Figure 11 shows the steps taken by the controller 102 when a user changes the presentation mode in which an information object is viewed. Firstly, in step S20, the  
15 controller 102 receives a signal from either the keyboard 16 or the mouse 18 identifying a component of information selected by the user. The controller 102 then, in step S22, receives a signal from either the keyboard 16 or the mouse 18 identifying a new presentation layer selected by  
20 the user.

In step S24 the controller 102 instructs the display driver 130 to display a message on the display unit 14 asking "Do you wish to save changes?". If the controller  
25 receives a signal from either the keyboard 16 or the mouse 18 indicating that the user does wish to save changes, then the routine proceeds to step S26 in which

the objects in the working memory 126 are saved in the second memory 120 replacing the objects in the second memory with identical object identifiers, and the routine proceeds to step S28 in which the working memory is  
5 cleared. If the controller 102 receives a signal indicating that the user does not wish to save changes, then the routine proceeds directly to step S28.

The controller 102 then instructs the selector 104 in  
10 step S30 to transfer the presentation layer corresponding to the presentation mode selected in step S22 to the controller 102.

Next, in step S32, the controller 102 instructs the  
15 filter 106 to transfer all the information objects and link objects relevant to the selected presentation layer stored in the second memory 120 to the working memory 126. In this step, if the selected presentation mode is the text mode or the tree diagram mode all the objects  
20 stored in the second memory 120 are transferred to the working memory 126. However, if one of the data flow diagram mode, state transition diagram mode or entity relationship diagram mode is selected, the filter 106 will only transfer those information objects and link  
25 objects for which the attribute corresponding to the selected presentation mode indicates the object is relevant. Only transferring those objects that are

relevant to the selected presentation mode has the advantage that, for the data flow diagram mode, state transition diagram mode and entity relationship diagram mode, the amount of data processed by the controller 102 is reduced thereby increasing the processing speed.

The controller 102 proceeds, in step S34, to identify the object corresponding to the component of information selected in step S20, which will henceforth be referred to as the selected object, and identifies, from the link attributes 150 of the selected object, the object identifiers of the link objects associated with the selected object. The controller 102 then searches the working memory 126 for these link objects, although as some of these link objects may correspond to presentation modes other than the selected presentation mode, not all of these link objects need be present. From those which are present, the controller 102 is able to identify those information objects, henceforth referred to as connection objects, to which the selected information object is connected. The controller then continues by looking for links between the connection objects and links between the connection objects and other information objects until a complete set of information objects and link objects is identified. The controller then, in step S36, sends signals to the display driver 128 for displaying this complete set on the display unit 14 in the selected

presentation mode.

The user is able to amend the information stored in either the information objects or the link objects using the keyboard 16 and the mouse 18. The user is also able to create a new object which involves inputting an object number indicating where the component of information to be stored in the new object fits within the hierarchical structure and the object identifiers of the information objects to which the new object is connected. The user can also create a new link object which involves inputting the object identifiers of a start information object and an end information object.

An advantage of storing components of information in respective information objects is that irrespective of which presentation mode is being used when the component of information is amended, provided the amended object is saved or otherwise retained prior to changing to a new presentation mode the component of information will appear in amended form in the new presentation mode. This reduces the amount of work which needs to be carried out the by user and eliminates the possibility of errors occurring when copying the amendments in other presentation modes, which is particularly advantageous because errors could be very difficult to detect. Thus, a user is able to create or amend data using a graphics

mode and then view the newly created or amended data in  
a text mode without having to perform any additional  
amendments, or alternatively create or amend data in a  
text mode and then view the newly created or amended data  
5 in a graphics mode.

In a second embodiment of the invention, a number of  
conventional computers are connected to form a  
conventional computer network.

10

As shown in Figure 12, all of the computers 150 are  
connected to a common database 152 in which documents are  
stored. Thus, a user working at any of the computers 150  
can access and amend a document stored in the database  
15 152. In order to do this, a user selects a document  
stored in the database 152 and the information objects  
and link objects of that document are transferred to the  
computer 150 at which the user is working and stored in  
a memory corresponding to the second memory 120 in the  
20 first embodiment. The user is then able to work on the  
document in the same manner as described for the first  
embodiment, with the exception that at the end the user  
is given the option of saving the amended document in the  
database 152 in place of the version of that document  
25 currently stored there.

In such a set-up, however, it is important that two

people are not amending the same document as this would lead to the possibility of changes made by one user being lost when the changes of another user are saved in the database. To avoid this situation occurring, when a user  
5 copies a document from the database 152 to one of the computers 150, a flag is stored in the database 152 with the copied document indicating that the copied document is currently being worked on. If a second user accesses the that document, while the user will be able to copy  
10 the document to a computer 150, the flag will prevent the second user from amending the document.

A number of modifications can be made to the above-described embodiments without departing from the concept  
15 of the invention.

In the first embodiment, the controller 102 instructs the filter 106 in step S32 to transfer the information objects and link objects relevant to a selected  
20 presentation layer to the working memory 126 after the selector 104 has transferred the selected presentation layer to the controller 102. However, the transfer of the relevant information objects to the working memory 126 could be performed concurrently with the  
25 transfer of the selected presentation layer to the controller 102 which has the advantage of increased processing speed.

It will be appreciated that the invention has been described with reference to a software package run on a conventional computer as this is the preferred method of implementation because all that a purchaser need buy, assuming that the purchaser already owns a suitable computer, is a disk having the computer program stored thereon or alternatively the purchaser could buy the computer program over the internet. However, the invention could be implemented as a dedicated apparatus.

10

The skilled person will also appreciate that while the first memory 108 and second memory 120 of the first embodiment have been described as if they were completely separate, the first memory 108 and the second memory 120 could in fact be parts of the same memory which could be, for example, a disk 122 or a hard drive memory.

15

While for exemplary purposes the first embodiment was described for the case in which the document consists of a single information module and a single link module, more commonly documents will have plural information modules and plural link modules for storing intra-module and inter-module links. For example, a document may have one module specifying all the safety requirements stipulated by law for a system and another module specifying all the user requirements.

20

25

In some instances a document may contain a module whose contents should not be changed, for example the safety requirements module mentioned above. In these instances, those of the modules whose contents should not be changed  
5 can be made read only, in other words their contents can be viewed but not amended.

In the first and second embodiments each information object has three attributes for storing data indicating  
10 whether or not the component of information stored in that object is relevant to the data flow diagram mode, state transition diagram mode and entity relationship diagram mode respectively. In a preferred embodiment, when a component of information is displayed in one of  
15 the presentation modes, markers are also displayed indicating the other presentation modes for which that component of information is relevant. This helps the user quickly move between modes.

20 The first and second embodiments have also been described specifying a relatively small number of attributes for ease of explanation. Further attributes can be created for storing values indicating the importance of the information stored in the object, the date the object was  
25 created, the person who created the object, the date the object was last amended and the person who last amended the object.



The history of the development of an object can be a very valuable tool. Preferably, each time that an object is updated, the old version of the object is saved. Then, for example, if a mistake has been found it is possible  
5 to trace when that mistake occurred and to delete all objects updated since that date and replace them with the versions of those objects at the date the mistake occurred.

10 Although in the above-described embodiments links between information objects have been stored as link objects with each information object only storing the object identifier of each relevant link object, alternatively each information object could store all the information  
15 concerning the links attached to that information object as values of attributes.

As has been described above, the present invention provides an apparatus which enable large amounts of  
20 information to be displayed to a user and amended by the user efficiently.

Claims

1. An information processing apparatus for processing  
5 information stored as a plurality of information objects,  
each information object having associated therewith a  
plurality of attributes for storing data indicating  
characteristic details of the information stored in that  
information object, said information processing apparatus  
10 comprising:

a first memory region for storing the plurality of  
information objects;

a second memory region for storing a plurality of  
presentation layers, each of the presentation layers  
15 corresponding to a respective different format for  
displaying at least part of the information stored in the  
information objects on a display;

means for selecting one of the presentation layers  
stored in the second memory region; and

20 means for displaying at least part of the  
information in the format corresponding to the  
presentation layer selected by said selecting means,

wherein said second memory region stores a  
presentation layer operable to display information in a  
25 format selected from the group of formats comprising a  
data flow diagram, a state transition diagram and an  
entity relationship diagram.

2. An apparatus according to claim 1, wherein each information object has an attribute for indicating whether or not that information object is relevant to a predetermined one of the plurality of presentation layers, and the apparatus includes second selection means for selecting information objects for display on the basis of said attribute.

3. An information processing apparatus for processing information stored as a plurality of information objects, each information object having associated therewith a plurality of attributes for storing data indicating characteristics of the information stored in the information object, said information processing apparatus comprising:

a first memory region for storing the plurality of information objects;

a second memory region for storing a plurality of presentation layers, each of the presentation layers corresponding to a respective different format for displaying at least part of the information stored in the information objects on a display;

means for selecting one of the presentation layers stored in the second memory region; and

means for displaying at least part of the information in the format corresponding to the

presentation layer selected by said selection means,

wherein each information object has an attribute indicating whether or not that information object is relevant to a predetermined one of the plurality of presentation layers, and the apparatus includes second  
5 selection means for selecting information objects for display on the basis of said attribute.

4. An apparatus according to claim 2 or 3, wherein the  
10 predetermined presentation layer includes the second selection means.

5. An apparatus according to any of claims 2 to 4, further comprising means for transferring the information  
15 objects selected by the second selection means from the first memory region to a third memory region.

6. A method of processing information comprising:  
separating the information into a plurality of  
20 information components;

storing each of the information components in a respective information object, each information object having associated therewith a plurality of attributes for storing data indicating characteristic details of the  
25 information components stored in that information object;

storing a plurality of presentation layers, each of the presentation layers corresponding to a respective

different format for displaying at least part of the information stored in the information objects on a display;

selecting one of the stored presentation layers in  
5 response to a user instruction; and

displaying at least some of the information components in accordance with the selected presentation layer,

wherein said selecting step comprises selecting a  
10 presentation layer for displaying information in a format from the group of formats comprising a data flow diagram, a state transition diagram and an entity relationship diagram.

15 7. A method according to claim 6, wherein said storing step comprises storing information in an attribute of each information object indicating whether or not that information object is relevant to a predetermined presentation layer.

20 8. A method according to claim 7, further including a second selecting step for selecting for display only those information objects which are relevant to the selected presentation layer, on the basis of the  
25 attributes of the information objects.

9. A method of processing information comprising:

separating the information into a plurality of information components;

storing each of the information components in a respective information object, each information object  
5 having associated therewith a plurality of attributes for storing data indicating characteristic details of the information components stored in that information object;

storing a plurality of presentation layers, each of the presentation layers corresponding to a respective  
10 different format for displaying at least part of the information stored in the information objects on a display;

selecting one of the stored presentation layers in response to a user instruction; and

15 displaying at least some of the information components in accordance with the selected presentation layer,

wherein said storing step comprises storing information in each information object indicating whether  
20 or not that information object is relevant to a predetermined presentation layer.

10. A method according to claim 9, further including a second selecting step for selecting for display only  
25 those information objects which are relevant to the selected presentation layer, on the basis of the attributes of the information objects.

11. A method according to either claim 9 or claim 10,  
wherein said selecting step comprises selecting a  
presentation layer for displaying information in a format  
from the group of formats comprising a data flow diagram,  
5 a state transition diagram and an entity relationship  
diagram.

12. A method according to either claim 8 or claim 10,  
further comprising the step of transferring the  
10 information objects selected in the second selection step  
to a working memory.

13. A method according to claim 12, wherein said  
selection step and said second selection step are  
15 performed concurrently.

14. A computer program product for enabling a  
programmable apparatus to carry out a method as claimed in  
any of claims 6 to 13.

20

15. A storage medium storing the computer program  
product as claimed in claim 14.

16. A signal carrying the computer program product as  
25 claimed in claim 14.

16. An apparatus substantially as described hereinbefore

with reference to or as illustrated in the accompanying figures.

17. A method substantially as described hereinbefore  
5 with reference to or as illustrated in the accompanying  
figures.





Application No: GB 9920075.0  
Claims searched: 1

36  
Examiner: Leslie Middleton  
Date of search: 26 January 2000

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): G4A ( AUB, AUDB )

Int Cl (Ed.7): G06F 17/30

Other: Online: EPODOC, PAJ, WPI / EPOQUE

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	EP 0883068 A2 ( Home Information Services ) See Fig.3, and description thereof	1 at least
X	WO 98/36343 A2 ( Intel Corpn ) See pp. 1-7,11 and 14.	1 at least
X	WO 95/26532 A2 (British Telecomms. ) Whole document	1 at least
X	EP 0589070 A1 ( IBM ) See pp. 1-7, especially	1 at least
X	US 5933831 A ( LSI Logic ) Whole document	1 at least
X	US 5019961 A (Cadware Inc ) Whole document	1 at least
X	Procs. 21 <sup>st</sup> Ann. Hawaii Intl. Conf. System Sciences, 1988 Vol II, pp.694-704 Graphical Entity Relationship Database Browser Burns L M et al	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.